



TEST REPORT



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Date: 19 th January 2010	Request No: 0032
Engineer: John Heppenstall	Originator: James Derby
19/01/2010	19/01/2010
X  <hr/> John Heppenstall Test Manager	X  <hr/> James Derby Technical Manager
Checked:	Authorised:
Product: TC2 Micro	Customer: National Grid US
SUBJECT: TC2 Micro Prototype Test	

Summary:-

The TC2 Micro prototype unit successfully passed the prototype test programme.

Object:-

TC2 Micro Prototype Test

Samples:-

1 off TC2 v1.0/1 Micro Prototype

Standards/Procedures (as applied):-

TS004 – National Grid US Prototype Test Specification

Test:-

The following tests were conducted on the test sample:- RFT-032

- Test A - Environmental Operating Conditions: 40°C, -20°C, 85% RH
- Test E – Audible noise @ 1m
- Test H – Temperature Rise Test
- Test L – Steady State Performance
- Test M – Dynamic Performance
- Additional Test – Leak Check Manifold/Solenoid Block



Figure 1: UUT



Figure 2: UUT in Environmental Chamber

Results:

Test A – Environmental Operating Conditions

The UUT was installed within the environmental chamber. Temperature setpoints & soak times were applied and measurements taken. Appendix A details the log history. No functional issues arose during the testing. The LCD display was found to washout at the colder temperatures. The LCD contrast pot was set to maximum before the final cold test and the display was found to be easily readable.

Table 1: Test A – Environmental Operating Conditions

Date	Condition	Temp	%RH	Pass/Fail
30/11/09	Hot >16hr soak	40°	n/a	Pass
4/12/09	Warm/Damp 96hr soak	30°C	85%	Pass
7/12/09	Cold > 2hr soak	-20°C	n/a	Pass
11/12/09	Warm/Damp 96hr soak	30°C	85%	Pass
11/12/09	Function @ STP	n/a	n/a	Pass

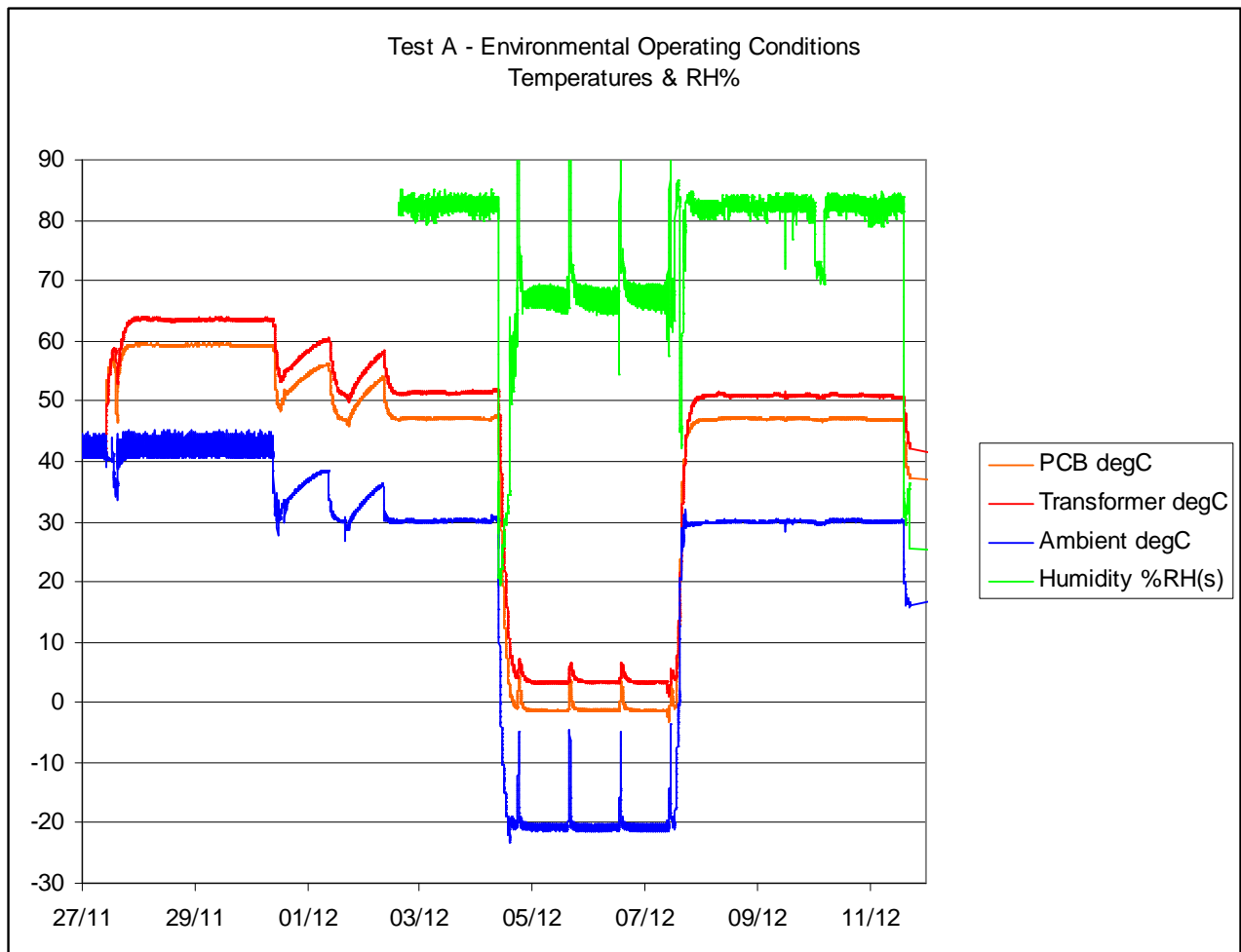


Figure 3: Showing temperature & humidity profile during Test A. Note: RH sensor not logged during initial testing.

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Test E – Audible Noise

Noise measurements were taken from the front and rear of the UUT @ 1m.

Table 2: Test E – Audible Noise

Date	UUT Mode	Position	Spec	Result	Pass/Fail
7/1/10	Standby	Front	< 60dbA	47.2dBA	Pass
7/1/10	UPS	Front	< 75dBA	74.6dBA	Pass
7/1/10	UPS	Rear	Info only	77.8dBA	n/a

Test H – Temperature Rise Test

Temperature measurements of the main components were taken during Test A. The highest temperature was found on the transformer frame of 64°C and the minimum temperature on the PCB as -1°C. The unit was not run long enough in UPS mode for a steady state running generator temperature to be measured. Experience with these generators has shown this item is not a concern under the specified loads and run time durations.

Table 3: Test H – Differential Temperatures

Set Point	DC-DC Converter	PCB	Transformer	Generator
40°C	+20.6°C	+18.4°C	+22.6°C	+15.5°C
-20°C	+21.1°C	+19°C	+23.7°C	+16°C

Table 4: Test H – Max/Min Temperatures

Set Point	DC-DC Converter	PCB	Transformer	Generator
40°C	+61.6°C	+59.4°C	+63.6°C	+56.5°C
-20°C	+1.1°C	-1°C	+3.7°C	-4°C

Test L & M – Steady State & Dynamic Performance Class

Output voltage was monitored for a period to assess any changes outside the proscribed Class limits. The UUT was cycled through its operating modes and states with load variations according to required Class performance. Figure 4 shows the output voltage and limits for Test M with the UUT being cycled through its operating modes.

Maximum voltage variation occurred with changes to output load. The measured output voltage variations fell well within the performance class limits.

Maximum measured variation @ steady state = $\pm 0.2\%$ VAC ($\pm 2\%$ limit Class 2)

Maximum measured variation @ dynamic = $\pm 0.7\%$ VAC (15% limit Class 2 with <0.7s recovery)

Table 5: Test L & M – Performance Class

Test	Start State	End State	Limits	Measured	Pass/Fail
L	Standby 100% load	Standby 100% load	$\pm 2\%$ VAC	$\pm 0.2\%$ VAC	Pass
L	UPS 100% load	UPS 100% load	$\pm 2\%$ VAC	$\pm 0.2\%$ VAC	Pass
M	Standby 100% load	Standby 5% load	$\pm 15\%$ VAC, 0.7s	+0.7% VAC, <0.7s	Pass
M	Standby 5% load	Standby 100% load	$\pm 15\%$ VAC, 0.7s	-0.7% VAC, <0.7s	Pass
M	Standby 100% load	UPS 100% load	$\pm 15\%$ VAC, 0.7s	$\pm 0.2\%$ VAC, <0.7s	Pass
M	UPS 100% load	UPS 5% load	$\pm 15\%$ VAC, 0.7s	+0.7% VAC, <0.7s	Pass
M	UPS 5% load	UPS 100% load	$\pm 15\%$ VAC, 0.7s	-0.7% VAC, <0.7s	Pass
M	UPS 100% load	Standby 100% load	$\pm 15\%$ VAC, 0.7s	$\pm 0.2\%$ VAC, <0.7s	Pass
M	Standby 100% load	Standby 5% load	$\pm 15\%$ VAC, 0.7s	+0.7% VAC, <0.7s	Pass
M	Standby 5% load	UPS 5% load	$\pm 15\%$ VAC, 0.7s	$\pm 0.2\%$ VAC, <0.7s	Pass
M	UPS 5% load	Standby 5% load	$\pm 15\%$ VAC, 0.7s	$\pm 0.2\%$ VAC, <0.7s	Pass

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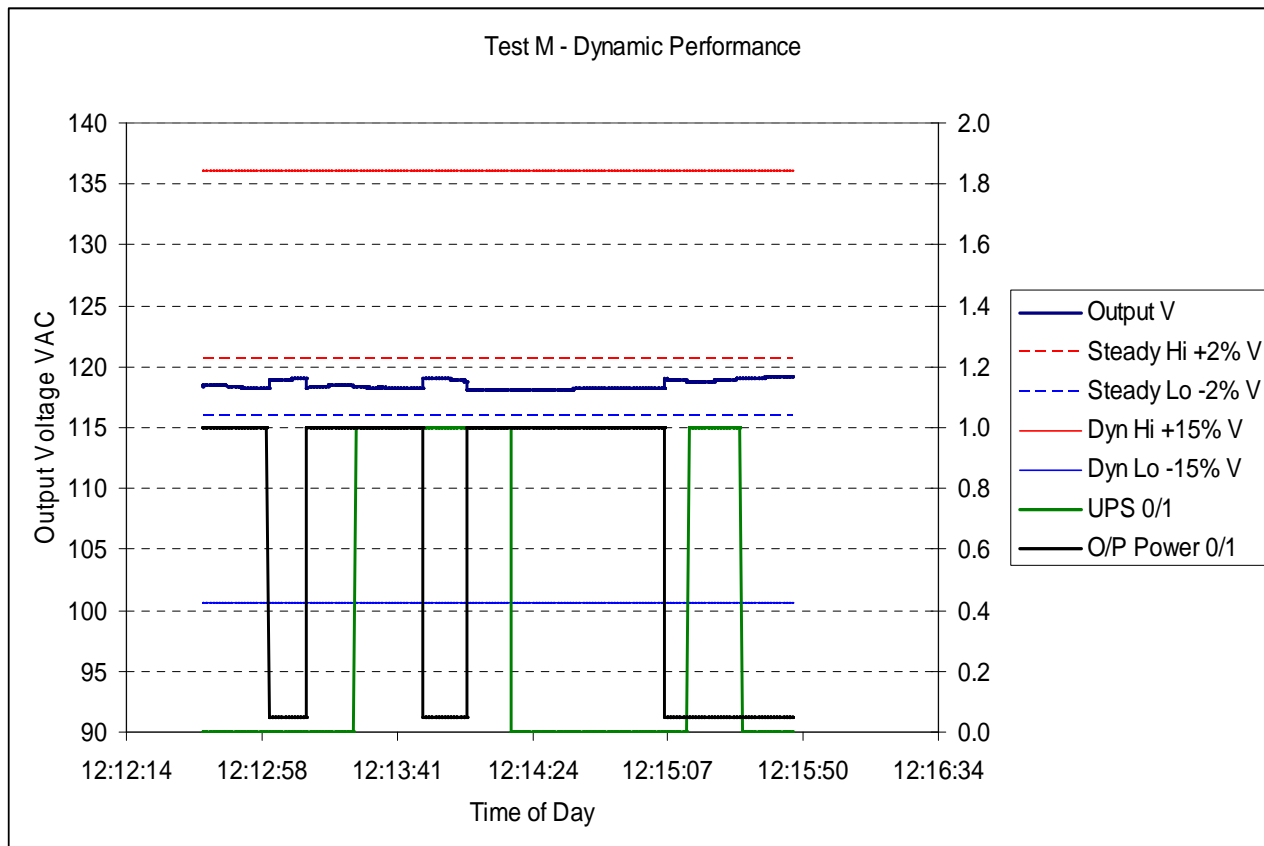


Figure 4. Measured output voltage during Steady State and Dynamic Performance Class tests

Additional Test – Leak Check Manifold Block/Solenoid Valve

The solenoid valve was found to be passing during Test A. The Manifold was sent back to Hale Hamilton for testing. The problem was identified and fixed. After return the manifold was refitted and the UUT was subjected to temperature cycling between its operating limits (40°C & -20°C) with good soak times between.

Table 5: Additional Test – Leak Check

Date	Temp	Leak Check
21/12/09	40°C	OK
22/12/09	-20°C	OK
4/1/10	40°C	OK
5/1/10	-20°C	OK
5/1/10	40°C	OK
7/1/10	-20°C	OK

Conclusion:

- TC2 Micro passed the prototype test specification without major issues

Recommendations:

- LCD display contrast ‘pot’ should be set to maximum for cold weather operation

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Appendix 1

Log history (data files can be found in the electronic job folder)

Date	Time	Temp °C	%RH	Function	Notes
27/11/2009	14:00	15°C	n/a	OK	40°C Set
30/11/2009	08:35	41°C	n/a	OK	Running smooth. 30°C 85%RH set
30/11/2009	11:33	30°C	83%	-	OK
30/11/2009	13:40	30°C	50%	-	Chamber pump fault. Fixed.
30/11/2009	16:13	34°C	83%	-	OK
1/12/2009	08:15	38°C	83%	-	Chiller ON
1/12/2009	09:04	31°C	79%	-	OK
1/12/2009	16:31	28°C	82%	-	Chiller OFF
2/12/2009	07:24	36°C	83%	-	Chiller ON. Humidity set 87%
2/12/2009	16:15	30°C	84%	-	OK
3/12/2009	09:05	30°C	83%	-	OK
3/12/2009	14:00	30°C	84%	-	OK
4/12/2009	07:55	30°C	81%	-	OK
4/12/2009	08:36	30°C	85%	OK	Transformer dT 21°C, CPU dT 17°C
4/12/2009	08:44	30°C	85%	OK	Run OK. Solenoid believed leaking. E2P clicking. Pressure gauge oscilating. Func OK. -20°C set.
7/12/2009	08:33	-20°C	-	OK	Solenoid still passing.
7/12/2009	12:03	-20°C	-	-	LCD display faint but readable. 30°C 85%RH set.
7/12/2009	16:51	30°C	82%	OK	Function OK. Still passing.
8/12/2009	08:29	30°C	82%	-	OK
8/12/2009	13:29	30°C	84%	-	OK
9/12/2009	08:50	30°C	81%	-	OK. Leak check. Solenoid passing.
10/12/2009	07:57	30°C	81%	-	OK
11/12/2009	08:51	30°C	82%	OK	30 secs no problems.
11/12/2009	13:32	30°C	82%	-	OFF
11/12/2009	13:53	-	-	OK	Function test OK. Manifold stripped out.
21/12/2009	-	40°C	-	OK	Returned manifold refitted. Leak check OK.
22/12/2009	-	-20°C	-	OK	Leak check OK.
23/12/2009	-	-	-	-	Heater problems. Test suspended.
4/1/2010	10:34	-	-	-	40°C set.
4/1/2010	15:31	40°C	-	OK	Leak check OK. -20°C set.
5/1/2010	08:21	-21°C	-	OK	Leak check OK. 40°C set.
5/1/2010	14:02	40°C	-	OK	Leak check OK. -20°C set.
7/1/2010	10:30	-20°C	-	OK	Leak check OK. OFF